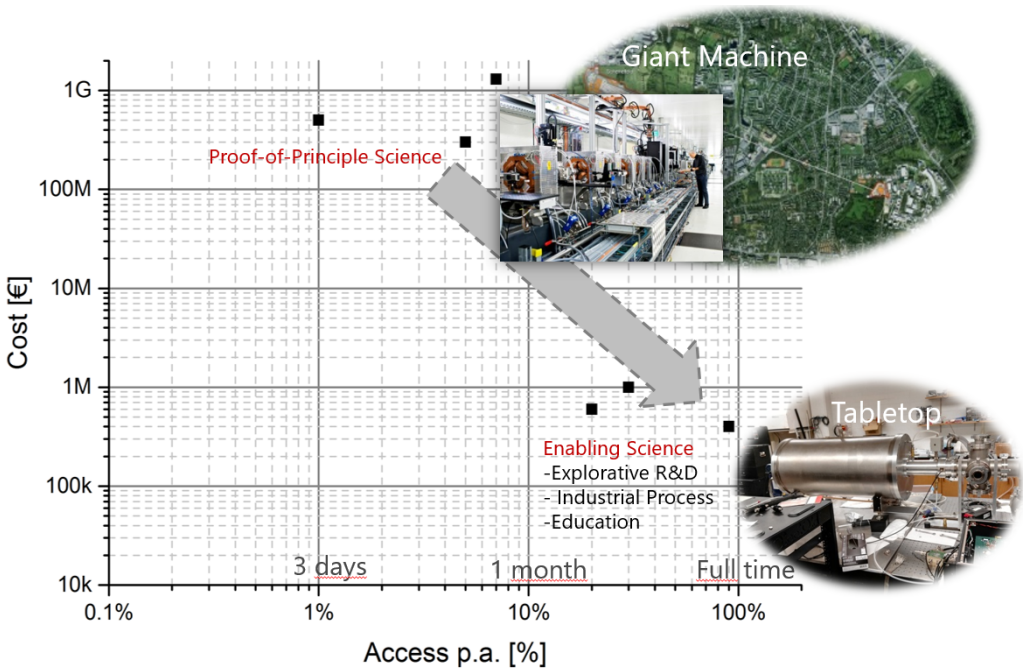
X-ray Lasers on a Tabletop – Things to Know before You Crave for a FEL

Davide Bleiner, Di Qu, Yousuf Hemani, Corino Wyder, Matthias Trottmann, Adrian Wichser

Empa Materials Science & Technology, Laboratory for Advanced Analytical Technologies,
Überlandstrasse 129, CH 8600 Dübendorf, Switzerland
davide.bleiner@empa.ch

Spectrochemistry is the instrumental analysis of substances with light pulses [1,2]. High brightness beams such as lasers, capillary discharges, etc. have dramatically contributed to the advancement of spectrochemistry, and largely replaced traditional continuous wave lamps. To extend this progress, intense pulses of even shorter wavelengths than state-of-the-art, such as in the extreme ultraviolet or soft/hard X-ray regions, are necessary. With that, one is able to carry out tabletop spectroscopy with high resolution in space, time and frequency.



Unfortunately, such advanced beams are not yet commercially available but only found at synchrotron beamlines. Here, the user access is discontinuous, granted to large teams ("big science"), and mainly dedicated to proof-of-principle experiments. To fill the 24/7 gap between users and tools, prototypes of high-brightness short-wavelength sources for tabletop operation, have been developed. Complementary figures-of-merit make them unique for specific high resolution domains, such as generating tunable hard X-rays, monochromatic lines, or ultrafast pulses. Advantages of these tabletop high-brightness short-wavelength sources for spectroscopy are discussed as well as their limitations.

[1] Bleiner, D., Juha, L., & Qu, D. (2020). Soft X-ray laser ablation for nano-scale chemical mapping microanalysis. *Journal of Analytical Atomic Spectrometry*, **2020** 35(6), 1051-1070.

[2] Bleiner, D., Trottmann, M., Cabas-Vidani, A., Wichser, A., Romanyuk, Y. E., & Tiwari, A. N. (2020). XUV laser mass spectrometry for nano-scale 3D elemental profiling of functional thin films. *Applied Physics A*, **2020**, 126(3), 1-10.